Environmental Assessment

Awcomin Salt Marsh Restoration Project

Rye, New Hampshire

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Introduction

Salt marsh is one of the rarest native ecosystems in New Hampshire. Ammann *et al.* (1994) estimated that there are only 6,200 acres of salt marsh remaining in the state. Of those 6,200 acres, current estimates indicate that approximately 700 acres have been severely impacted by restrictions to tidal flow. Since the 1994 - study, approximately 530 of these 700 acres have been restored through a multi-agency cooperative effort.

The Awcomin Salt Marsh Restoration Project proposes to restore an additional 24.7 acres of salt marsh across route 1A from the Rye Harbor State Park boat launch parking lot. Project measures include the excavation and removal of approximately 95,000 cubic yards of dredge spoil from Rye Harbor. This material was placed on the marsh in the 1940's and again in the early 1960's during two harbor dredging operations. Included in this project are the installation of approximately 6,000 feet of reconstructed tidal creeks, three pannes, and two small wildlife islands to replace features of the marsh lost when it was filled.

There has been an ongoing restoration effort on the Awcomin marsh since the early 1990's. This has included breaching the 1940's and 1960's dikes with new tidal ditches and the removal of dredge spoil down to an elevation averaging around 4.3 feet NGVD (National Geodetic Vertical Datum of 1929) in several areas. NGVD is a standard reference elevation taken from Boston Harbor which roughly approximates mean sea level. In the last two years several meetings have been held to solicit input from local experts for a plan to complete the restoration. From these discussions, a conceptual restoration framework was adopted.

Plan Preparation

During the spring of 2001, NRCS personnel, under the direction of an NRCS engineer, conducted a detailed topographic survey of the project area. This survey was done with electronic survey equipment and included over 1000 data points. A detailed topographic map of the marsh was prepared from this survey data.

Using this map as a base, an NRCS biologist experienced in salt marsh restoration prepared a preliminary plan following the agreed upon restoration concepts. This plan included excavation of the marsh to an average elevation of 4.3 feet NGVD. It is expected that the coarseness of the excavation will result in elevations that vary between 4.0 and 4.5 feet. It is considered important to maintain the average elevation below 4.5 during the restoration process to reduce the possibility of re-invasion by phragmites. An elevation of 4.3 feet is two tenths below the typical lowest elevation for high marsh and conversely near the highest elevations of low marsh. Re-invasion by phragmites will be minimized because low marsh which it is flooded on each tide is too saline for this species. Excavation below typical high marsh elevations will also allow the reestablishment of peat by the development of a dense stand of *Spartina alterniflora. E*ventually, through normal marsh building over many years, the final elevation of the restored marsh will be between 4.5 and 5.0 feet. At that point the marsh will be high marsh dominated by *Spartina patens*. The plan also includes the installation of a system of tidal creeks (total 6,000 feet) to replace those lost when the marsh was filled.

A set of engineering plans was prepared and submitted to other agencies, regulators, and local experts for review. From their comments, a final set of plans were prepared and submitted to state and federal regulators as part of the application for state and federal wetlands permits.

Present Conditions

The 1940's and 1960's dikes form two relatively distinct areas within the project area. The outer 1940's dike was filled to a lesser depth (typically 0.5 to 1.5 feet) than the area within the inner 1960's dike which received fill during both harbor dredgings. Inside the 1960's dike the marsh was essentially buried with up to 10 feet of spoil. All original pannes and tidal creeks were obliterated.

Between the 1960's dike and the 1940's dike, what appears as salt marsh surface is actually marsh reformed on top of spoil. Unfortunately, while these areas received enough tidal flow (at least during extreme tides) to re-vegetate with marsh vegetation, the new surfaces were high enough to allow the subsequent invasion of phragmites. At the present time, most of the Awcomin marsh has been invaded by dense stands of phragmites except for the highest elevations toward Route 1A which are wooded.

During restoration efforts in the early 1990's, spoil was removed from several small areas within the present project area. These areas were completely re-vegetated with

marsh grasses within 4 years. Within these areas there are also indications that pannes are reforming.

Project Impacts

The planned project will restore normal marsh elevations that are presently buried under dredge spoil. Experience with marsh restoration in New Hampshire indicates that removal of fill from a buried salt marsh results in natural re-vegetation within 3 – 5 years. While this seems like a long time, it is important to remember that it is a relatively short time in the many thousand-year life of a marsh. The re-vegetation that has occurred within the project area due to prior restoration efforts is a site-specific indication that fill removal will restore the marsh. While it cannot be claimed that the re-vegetation of the excavated areas represents full restoration, it can be said that these reclaimed areas are closer in function to natural salt mashes than areas still buried.

The project will restore several marsh features and processes. These in turn will perform a suite of valuable functions typically associated with salt marshes such as fish and wildlife habitat, aesthetic quality and educational potential. The specific features and processes to be restored by this project are:

- **Tidal creeks and rivers** - Installation of approximately 6,000 feet of tidal creeks within the marsh will increase an important habitat for fish and wildlife. The sediment to be removed is primarily dredge spoil and peat buried by the spoil. Restoration of tidal creeks will also allow other functions such as food chain support for marine fisheries in the Gulf of Maine.

- **High and Low Marsh** - Excavation of the project area to an average elevation of 4.3 feet NGVD will create a preponderance of low marsh (marsh dominated by salt marsh cordgrass *Spartina alterniflora*). This elevation was selected to reduce the possibility of re-invasion by phragmites. Areas having an elevation of 4.5 or greater will tend towards high marsh (marsh dominated by salt meadow cordgrass S*partina patens* and a variety of salt adapted plants). Both high marsh and low marsh are valuable as habitat for animals, plants, and microscopic organisms.

- **Salt marsh pannes** (ephemeral and permanent pools) – The plan includes the installation of three pannes to replace those lost when the marsh was filled. Pannes are very important habitat for fish, wildlife, and certain plants such as widgeon grass. In addition to these deliberately constructed pannes, it is anticipated that additional pannes will form naturally as a result of variations in elevation introduced

during construction as well as a the reestablishment of salt marsh processes that govern panne formation..

- **Wooded buffer** – The decrease in undeveloped buffer around New Hampshire's coastal marshes is of increasing concern to State, Local, and Federal agencies and Non Governmental Organizations. Because of this it was decided to leave a portion of the wooded buffer that has developed on spoil along route 1A rather than restoring the entire area to salt marsh. This buffer will vary in width from approximately 100 feet to 250 feet and be approximately 900 feet in length.

A functional assessment of the project was also conducted by NRCS personnel using the procedures described in the documents "The Highway Methodology Workbook" (U.S. Army Corps of Engineers, undated) and the "Method for the Evaluation and Inventory of Vegetated Tidal Marshes in New Hampshire" (Cook et al., 1993). The best professional judgement of local experts was incorporated into these assessments. The area of the Awcomin marsh to be restored was assessed under both present conditions, and future with and without project. Five critical wetland functions were assessed: fish and shellfish habitat, wildlife habitat, flood flow alteration, educational/scientific value, and production and export of nutrients to marine fisheries. The data sheets for these analyses are included in appendix 1.

Restoration of the marsh will restore normal function for all of the functions assessed. Below is a discussion of these assessments for each of functions.

Fish and Shellfish Habitat

Fish habitat under existing conditions

Most of the fish habitat that existed in the marsh prior to the placement of dredge spoil has been lost. In the last decade, restoration efforts within the project area have restored a limited amount of tidal creeks and low marsh.

Fish habitat in restored marsh

Restoring 24.7 acres of the Awcomin salt marsh will increase habitat for anadromous, catadromous and amphidromous fish. One of the most important functions of salt marshes is to provide food chain support for the coastal fisheries in the Gulf of Maine. Much of the nutrients exported to coastal fisheries is in the form of forage fish such as Atlantic silversides (*Menidia menidia*) and mummichogs (*Fundulus heteroclitius*). These amphidromous fish move between salt and brackish water feeding on detritus and invertebrates.

Another important habitat function is to serve as nurseries/refuges for important fish such as winter flounder (*Pseudopleuronectes americanus*) and alewife (*alosa pseudoharengus*).

Published literature on range and habits of fish indicates that restoration of the marsh could reasonably be expected to increase potential habitat for the fish listed below. This does not mean that any or all of the listed fish will necessarily use the improved habitat or that the improved habitat is of high quality for all species. In addition, the actual use of the marsh by a particular species depends on non-habitat factors including the actual presence of a given species along this section of the coast. The list then should be viewed as simply an indication of the presence of potential habitat in the restored marsh.

- Rainbow Smelt *Osmerus mordax* (Mitchill) - Anadromous
- Alewife *Alosa pseudoharengus* (Wilson) - Anadromous
- Blueback Herring *Alosa Aestivalis* (Mitchill) - Anadromous
- Winter flounder *Pseudopleuronectes americanus* (Walbaum) - Amphidromous
- Mummichog *Fundulus heroclitus* (Linnaeus) - Amphidromous
- Banded Killifish *Fundulus diaphanus* (Lesueur) - Amphidromous
- Threespine Stickleback *Gasterosteus aculeatus* (Linnaeus) - Amphidromous
- Fourspine Stickleback *Apeltes quadracus* (Mitchill) - Amphidromous
- Ninespine Stickleback *Pungitius pungitius* (Linnaeus) - Amphidromous

Wildlife Habitat

Wildlife habitat under existing conditions

Existing wildlife habitat in the marsh is threatened by the invasion of phragmites, purple loosestrife, and narrow leaf cattail, plants that generally lower the wildlife habitat value of tidally restricted salt marshes. These species, especially phragmites and purple loosestrife, tend to create monocultures with low habitat value. Additional loss of salt marsh habitat has occurred by the invasion of shrubs and freshwater marsh plants around the edge of the marsh. While these plants have value for wildlife, they are nevertheless encroaching on areas of historic salt marsh, one of the rarest habitats in New Hampshire.

Those wooded areas near route 1A without dense phragmites stands have a moderate value as upland habitat.

Wildlife habitat in a restored marsh

Salt marshes have been identified as having high habitat value by the New Hampshire Resources Protection Project (Ueland, *et al*., 1995). Obviously, increasing the area of sustainable functioning salt within the Awcomin marsh by an additional 24.7 acres will significantly increase the amount of salt marsh habitat available along the New Hampshire seacoast.

Wildlife that will specifically benefit from the restoration of the marsh include:

- Shore birds (e.g. least sandpiper, willet, greater and lesser yellowlegs)
- Waterfowl (e.g. black duck, mallard)
- Song birds (e.g. sharp-tailed sparrow, seaside sparrow)
- Birds of prey (e.g. harrier)
- Wading birds (e.g. green heron, great blue heron, snowy egret)
- Small mammals (e.g. muskrat)
- Large mammals (e.g. white-tailed deer)

Several acres of early succession wooded upland habitat that has grown up on the spoil will be converted to salt marsh habitat as a result of the project. We believe that this loss is far outweighed by the gain in both wildlife and fish habitat in the restored marsh.

Flood Flow Alteration

Flooding under present conditions

The proposed project will not affect the 100year (1-percent chance event) flood elevation in the vicinity of the marsh, which is calculated to be 9.2 feet NGVD.

Within the project area, the level of flooding from tides depends on the height of fill. Areas that have been filled above 7 feet NGVD are unlikely to be flooded by tides except under extreme storm conditions. To put this elevation in perspective, much of route 1A in front of the project area is at an elevation of 8 feet NGVD. Areas closer to the typical elevation of natural high salt marshes in the area of 4.5 – 5 feet NGVD are flooded by the twice-monthly spring tides. Areas below 4.5 feet (typically in ditches) are flooded by each tide where connected to a tidal creek.

Flooding in a restored marsh

Given the target elevation of 4.3-feet NGVD, tidal flooding in the restored marsh will be comparable to low marshes in the area. The Planned project will not cause increased flooding of the areas around the historic marsh.

Educational/Scientific Value

Educational potential under present conditions

Presently the marsh is in a seriously degraded condition. Its educational/scientific potential is limited to showing what a degraded salt marsh looks like. This condition is predicted to worsen over time as phragmites spread further.

Educational/scientific potential in a restored marsh

Restoration of the marsh will provide an opportunity to document the return to health the largest filled salt marsh ever to be restored in the state. This is in addition to the obvious educational and scientific value of having a large, fully functioning salt marsh in public ownership.

Production and export of nutrients to marine fisheries

Production and export under present conditions

One of the important functions of salt marshes is the export detritus and nutrients. This process is limited under current conditions by the fact that much of the project is buried under dredge spoil and is no longer a salt marsh. The remainder of the project area buried by less than a foot of fill retains some salt marsh function but has largely been invaded by phragmites. Small areas of the project area have been previously restored by fill removal and ditching and appear to be recovering. These areas are now almost completely vegetated with *Spartina* and other marsh plants. The re-vegetation was by natural seeding and took about four growing seasons. The pattern of re-vegetation seems to have followed the normal pattern for salt marshes in that Salicornia spp. was the first plant to appear on the newly excavated areas. This limits the flow of nutrients in the form of detritus as well as the propagation and export of forage fish.

Production and export in a restored marsh

Increased tidal flow will probably increase the export of usable nutrients because of the expected increase in fish habitat and the resulting increase in the production of forage fish in the marsh.

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